STAR Note #51

Annulus Scintillator Trigger Detector at High η

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1 Introduction

In a fixed target experiment, the minimum bias trigger is generated typically by examining the beam phase space for the presence of the projectile before the target and for the absence of the projectile after the target. In a collider the strategy is to examine the phase space complementary to the beam for the appearance of particles resulting from the interaction. For example, SPS $p\bar{p}$ experiments generally examine a large region of phase space for a minimum bias trigger, typically η in the range 1 to 5. The coverage is dependent on the physical constraints of the experiment.

We will describe an annular scintillator system to be used in such a trigger. The two main functions of a small scintillator annulus near $\eta = 5$ is to extend the multiplicity measurement into the high η region and to provide fast vertex location for the minimum bias trigger in order to filter out beam gas and halo events that come at the wrong time and location.

2 Design

The present design is to have 16 segments in each of the two symmetric detectors as shown in figure 1. The inner radius is 4 cm and the outer 11 cm. The detector will cover η from 4.5 to 5.5 at Z position of ± 4.9 meter. Each segment shown in figure 2 is 20.6 sq cm in cross sectional area and 2.5 cm thick BC420 scintillator. A single phototube (1 inch diameter Hamamatsu R3432) will be coupled to a scintillator segment via Acrylic plastic UVT light guide. We may also use optical fibers instead of plastic light guides. Since the effective area of the phototube is about 2 sq. cm, we will collect at most $2/20.6 = 9.7\%$ of the light being produced in the scintillator. Of course there will be more loss due to transmission through the light guide. The main purpose of the light guide is to provide uniformity of response.

The response of the trigger scintillators as a function of particle number has been studied using Au-Au collison events generated from Fritiof and GEANT3. 32 events were tracked into a wedge scintillator at $z = 4.9$ m. An average of 6 primary and 5 secondary tracks per event were found. The pulse height of the individual particles in two categories of tracks are shown in figure 3a and 3b. There were 190 primary tracks and 160 secondary tracks. The tail at the large pulse height in the secondary spectrum is due to soft protons, which drop a large amount of energy in the scintillator.

The total pulse height seen by the scintillator versus the number of hits is plotted in figure 4. One entry is off scale, an event with 15 hits and a pulse height of 2500 units. This event had a particle which hit the beam pipe near the trigger counter and the resulting hadronic shower deposited five low energy protons and pions in the scintillator. Events such as this will result in large fluctutations in the pulse height, making it impossible to determine the exact number of hits in a given scintillator. But as figure 4 shows there is a correlation between the pulse height and the multiplicity. Thus the counter will be an useful trigger for central interactions. The above Monte Carlo also shows that the photocathode area will be hit by an incident particle only about 2/3 of the time. Thus the proposal to put a disk of Cerenkov radiator in front of the photo-cathode will produce substantial time jitter; approximately the rise time of the scintillator. Thus we do not recommend this option.

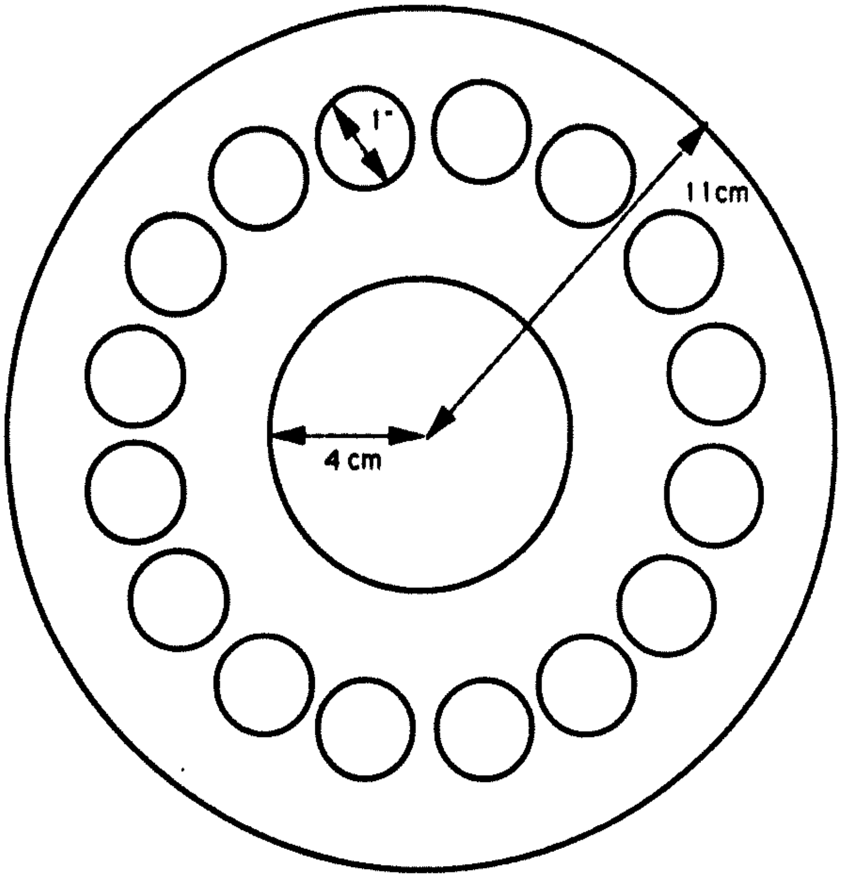

Figure 1:

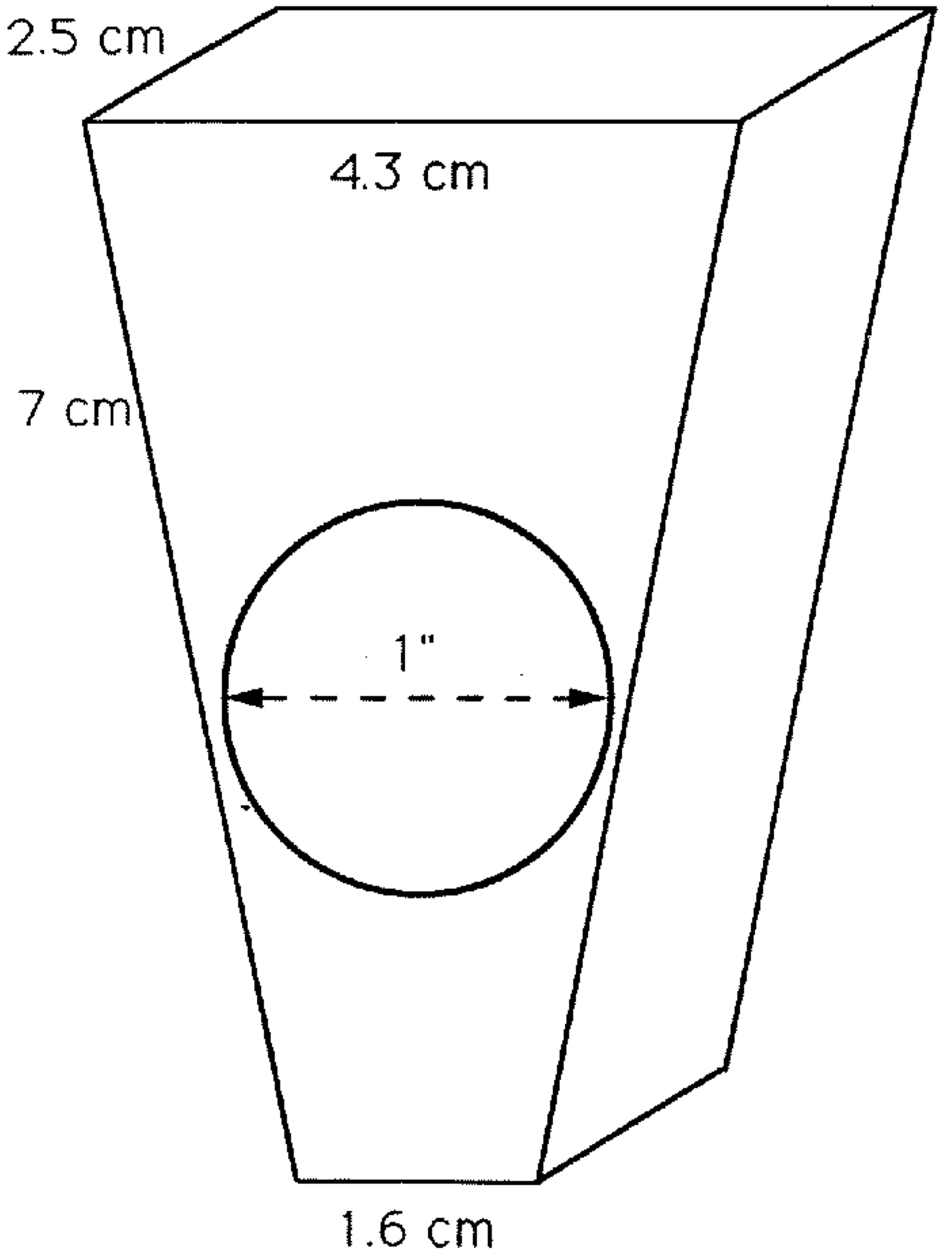

Figure 2:

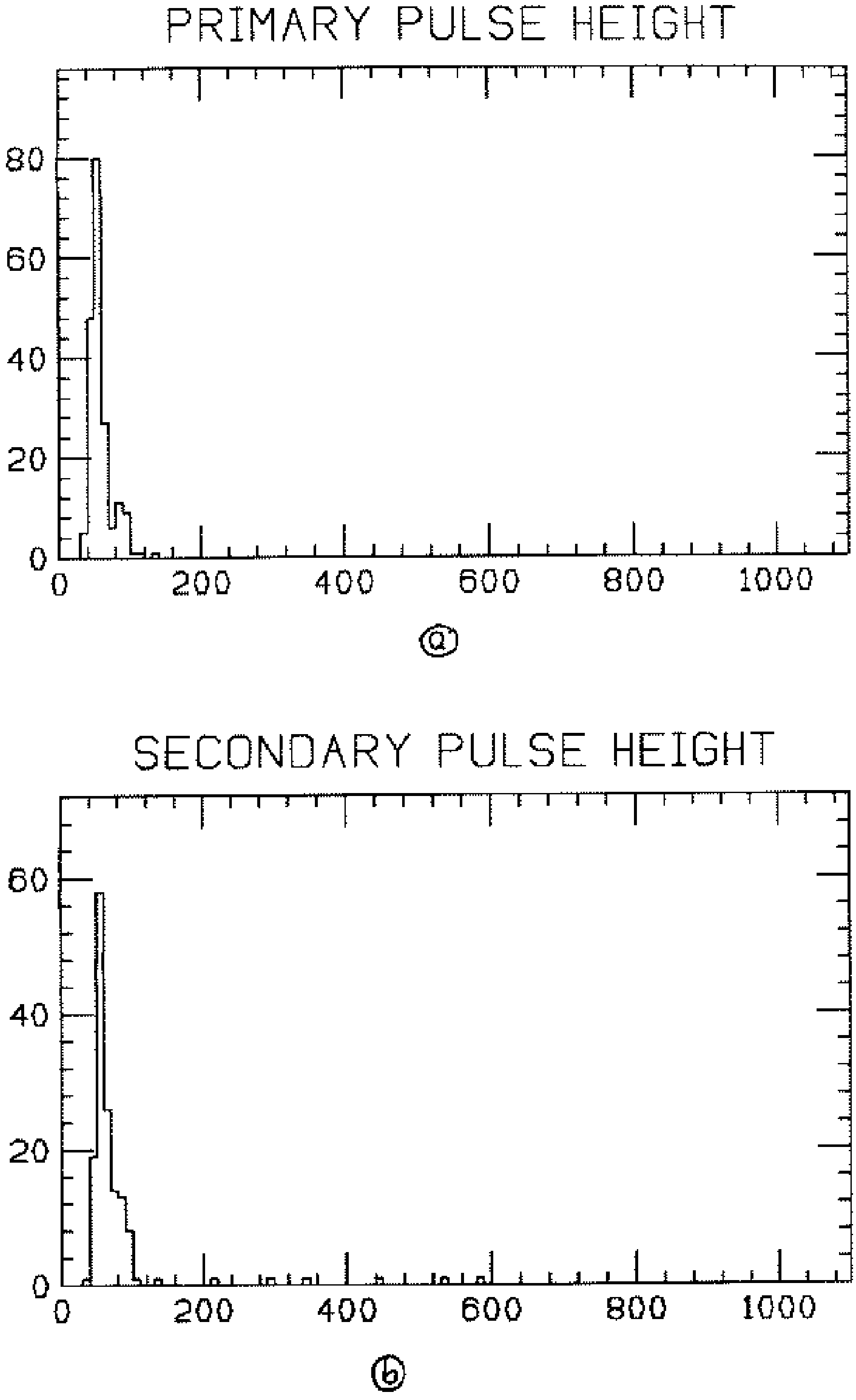
PRIMARY PULSE HEIGHT
80
60
40
20
0
0
200
400
600
800
1000
a
SECONDARY PULSE HEIGHT
60
40
20
0
0
200
400
600
800
1000
b

Figure 3:

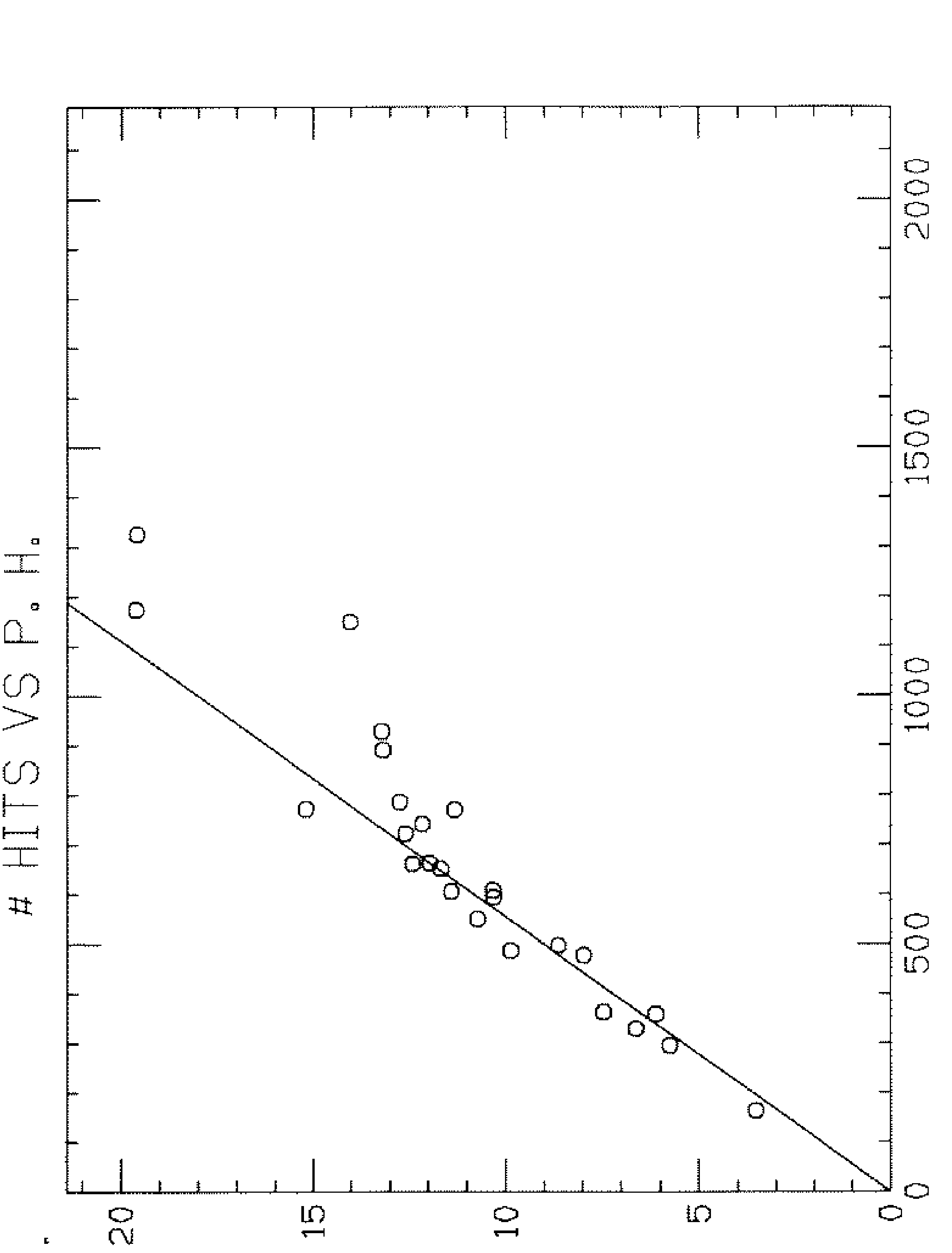

Figure 4: